[This question paper contains 5 printed pages.]

1467-A *Your Roll No.* .....

B.A./B.Sc. (Hons.)/II **A**

MATHEMATICS – Unit VIII

(Numerical Analysis and Computer Programming)

Time : 2 Hours *Maximum Marks : 30*

(Write your Roll No. on the top immediately on receipt of this question paper.)

All *questions are compulsory.*
Choice is given within the question.
Use of Scientific Calculator is allowed.

SECTION I

1. (a) Explain executable and non-executable statements with examples. (1)

(b) Write the FORTRAN equivalent of

$$\frac{x^3 + y^3}{\cos(x + y)} + e^{xy} - \sqrt{|x^2 - y^2|} \qquad (1)$$

(c) Evaluate the expression

MOD(INT(23 – 4.3), I * I) . LT . K .
OR . I + J/K . GT . J – 11
where I = 2, J = 15, K = 6 (1)

P.T.O.

(d) The following program calculates the circumference and area of a circle when the radius is given. The program contains many syntax errors. Rewrite the same program after removing the syntax errors.

```
1     6
C     Program to find the circumference
     +& area of a circle.
     +Radius is given.
      Read (*, *) R
      Real, R
      WRITE *, 'Radius is' R
      CIRCUMFE = 2πR
      AR = πR**2
      WRITE *, CIRCUMFE, AREA
      STOP.
```

(2)

(e) Write a program in FORTRAN 77 to find the mean and standard deviation of a given set of 20 numbers.

OR

Write a subroutine subprogram in FORTRAN 77 to test whether a given natural number is prime. (2)

SECTION II

2. Attempt any **two** parts :

(a) Using secant method find a positive root of $x^3 + x^2 - 3x - 3 = 0$. Do 3 iterations. Also write a program to implement it. (4)

(b) What do you understand by the term 'rate of convergence' of an iterative method for solving an equation ? Derive the rate of convergence of the Newton Raphson Method for solving an equation iteratively. (4)

(c) The equation $x^2 + ax + b = 0$ has two real roots α and β, show that

(i) the iteration method $x_{n+1} = -(ax_n + b)/x_n$ is convergent near $x = \alpha$ if $|\alpha| > |\beta|$

(ii) the iteration method $x_{n+1} = -\dfrac{b}{x_n + a}$ is convergent near $x = \alpha$ if $|\alpha| < |\beta|$

(iii) the iteration method $x_{n+1} = -\dfrac{\left(x_n^2 + b\right)}{a}$ is convergent near $x = \alpha$ if $2|\alpha| < |\alpha + \beta|$.

(4)

SECTION III

3. Attempt any **two** parts :

(a) Find the inverse of the coefficient matrix of the system of equations

$$x + y + z = 1$$

$$4x + 3y - z = 6$$

$$3x + 5y + 3z = 4$$

by Gauss Jordan method with partial pivoting. Hence solve the system. (4)

(b) For the system of equations

$$4x - y + z = 7$$

$$4x - 8y + z = -21$$

$$-2x + y + 5z = 15$$

set up the Gauss Jacobi Iterative Scheme. Do 3 iterations, using a suitable initial approximation. (4)

(c) Write a program in FORTRAN 77 to solve the system of equations

$$22x_1 + x_2 - x_3 - x_4 = 12$$

$$2x_1 + 13x_2 - x_3 + 2x_4 = 21$$

$$2x_2 + 30x_3 - 5x_4 = 11$$

$$x_1 + x_2 + x_3 - 6x_4 = -5$$

by Gauss Seidal Iterative method.

Use $x_1^{(0)} = x_2^{(0)} = 0$, $x_3^{(0)} = x_4^{(0)} = 1$ as the initial approximation. Do 8 iterations. Use comment statements to make the program understandable. (4)

SECTION IV

4. Attempt any **two** parts :

(a) Derive the interpolating polynomial for the function f(x) whose tabular values are given by :

x	3.2	2.7	1.0	4.8
f(x)	22	17.8	14.2	38.3

Use it to calculate f(3). (3½)

(b) (i) Define central difference operator δ and averaging operator μ and prove that

$$\mu = \sqrt{(1 + \frac{\delta^2}{4})}.$$

(ii) Calculate the nth divided difference of

$$f(x) = \frac{1}{x}.$$ (3½)

(c) Find the least square approximation of second degree for the discrete data

x	–2	–1	0	1	2
f(x)	15	1	1	3	19

(3½)